BEST STANDARDS FOR DATA COLLECTION AND REPORTING REQUIREMENTS ON FOBs: TOWARDS A SCIENCE-BASED FOB FISHERY MANAGEMENT

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SUMMARY

A major concern for tropical tunas, on these last years, has been the worldwide increasing use of drifting FOBs by purse seiners, which are equipped with satellite buoys and echo-sounders. The use of these floating objects has contributed to increase the catch of skipjack tuna, but also of juveniles of yellowfin and bigeye tunas. Moreover, it has increased the amount of by-catch (including some species classified as vulnerable or endangered) and has likely resulted in adverse effects on the ecology of fish and on vulnerable areas (e.g. beaching events on coral reef areas). Despite the increasing FOB use and concerns, little information is available on FOB use worldwide for an appropriate monitoring and management. Thus, FOB monitoring has become a priority in all tuna t-RFMOs. However, the data collection and reporting requirements around FOBs are not standardized and there are significant data gaps. The aim of this document is to review current requirements and procedures in place and propose standards for data collection and submission on FOBs to t-RFMOs. The proposals included in this document are the result of a collaborative work between scientists and the fishing industry.

KEYWORDS: floating object, FOB, fish aggregating device, FAD, tropical tuna, purse-seine, data collection, data reporting

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1. Introduction

Tropical tuna purse seiners operate globally fishing on free schools and on Floating Objects (FOBs), including man-made Fish Aggregating Devices (FADs) and other floating objects. Since the late 90s with the development of satellite-linked echo-sounder buoys for tracking FOBs (Lopez et al. 2014), the use of FOBs has continuously increased (Fonteneau et al. 2013), with FAD-associated catches now exceeding those on free schools in the case of the European Fleet. For example, the European tropical tuna purse seine fishery operating in the Indian Ocean has increased the percentage of FOB sets from 40% in 1990-1994 to 73% in 2010-2014 (Chassot et al., 2015, Ramos et al., 2017), following similar trend in the Atlantic Ocean. Along the document the term Floating Objects (FOBs), includes the man-made Fish Aggregating Devices (FADs) and other floating objects (Gaertner et al., 2016).

The increasing use of FOBs has introduced worldwide major changes in the tropical tuna purse seiners fishing patterns which could have affected the marine environment. In this sense, potential effects associated with the increased number of FOB deployments at sea has been described: alteration of normal movements of tuna (Marsac et al., 2001; Hallier and Gaertner, 2008), increased skipjack catches (the principal target species), reduction in yield per recruit of yellowfin and bigeye (from which small specimens co-occur in the catches with skipjack), increase in bycatch, potential impacts on coastal habitats and source of pollution (Dagorn et al. 2012, Maufroy et al., 2015, Davies et al., 2017). Despite these concerns, little information is available on FOB use worldwide while it is crucial for the understanding, monitoring and management of the impacts of FOBs on pelagic ecosystems. As a result, Tuna Regional Fisheries Management Organizations (t-RFMOs) have called for FAD management plans, including data collection on deployment and use of FOBs by purse seiners and supply vessels and data reporting requirements on FOBs to CPCs/t-RFMOs (ICCAT, 2016a, 2016b).

Although efforts are being made to record and report information on FOBs, including man-made FADs and other natural floating objects, due to the complexity of this fishing strategy and the lack of unified data collection and reporting requirements (an absence of harmonized definitions for relevant terms or ambiguity among t-RFMOs), there are significant data gaps (Ramos et al., 2017; Lopez et al., 2018) and the information collected so far by the skippers and available for analysis has been of limited utility. Several works have been conducted recently to analyze data collection and submission related problems and have proposed potential solutions, such as interpretations on the data collection and submission requirements or new FAD logbook templates to improve the quality of the data recorded (Báez et al., 2017a; Báez et al., 2017b; Ramos et al., 2017; Lopez et al., 2018). Some of these proposals have been implemented regionally or by some users. However, standardization among CPCs and t-RFMOs would be highly desirable. Therefore, efforts from all stakeholders are required to improve data collection and submission on FOBs. In this sense, the RECOLAPE project (MARE/2016/22, "Strengthening Regional cooperation in large pelagic fisheries data collection"), which seeks to improve the coordination among EU Member States in the fisheries data collection field in support of stock assessment and fisheries advice, aims to develop protocols for FOB data collection and data storage tools to meet the requirements of the tuna t-RFMOs. The aim of the present document is to summarize the results of the workshop which took place in the frame of RECOLAPE project during 24th and 25th of May in AZTI (Sukarrieta) in which t-RFMO requirements and other procedures in place were reviewed and standards for the collection and submission of FOB-related data were proposed. The proposals included in this document are the result of a collaborative work between scientists and the fishing industry.

2. t-RFMOs requirements

t-RFMOs have called for FAD management plans, including data collection on deployment and use of FOBs by purse seiner and supply vessels, and data reporting requirements on FADs to CPCs/t-RFMOs (Table 1). Recent works reviewed these t-RFMOs requirements including a detailed analysis of the data gaps, data requested on FAD-logbooks and other data submission specific forms (Ramos et al., 2017; Báez et al., 2017a; Báez et al., 2017b; Lopez et al., 2018), which are not repeated here. We briefly summarize and discuss the issues detected in each t-RFMO.

Table 1. t-RFMO data collection and reporting requirements on FOBs

t-RFMOS	Data Collection Requirements	Data Reporting Requirements
IOTC	Resolution 17/08 (para. 10) [Annex I and Annex 2]. No form provided	Resolution 17/08 (para. 9); Resolution 15/02 (para. 6); Guidelines for the reporting of fisheries statistics to the IOTC - Form 3FA
ICCAT	Rec. 16-01 (para. 21) Annex 2 form [activities with FADs] Annex 3 minimum standards; Rec. 16-01 (para. 22) - Annex 4 form [list of deployed FADs and buoys]	Rec. 16-01 (para. 23); Rec. 13-01 Form: ST08-FadsDep form
IATTC	C-16-01 (para. 2) Annex I FAD Form 9/2016 C-17-02	C-16-01 (para. 3); C-17-02 (para. 11, 12); Guidance in reporting on FADs in accordance with IATTC Resolution C-17-02: INF1; INF2
WCPFC	Not specified in the Resolutions Report - tenth meeting of the Tuna fishery Data Collection Committee	Not specified in the Resolutions

2.1. ICCAT

The International Commission for the Conservation of Atlantic Tunas (ICCAT) through Recommendation 16-01: Rec 16-01 (21) Annex 2 form [FAD logbook]; Annex 3 on the nomenclature of FADs and activities; and RES 16-01 (22) Annex 4 form [list of deployed FADs and buoys], proposed specific forms for data collection on FOBs including CECOFAD codes for type of floating objects and activities. In these forms an identification code is proposed for marking the FOBs in addition to the buoy ID. This marking scheme was previously applied with not promising results, and therefore the 2nd FAD Working Group of ICCAT concluded that the FADs should be marked/tracked by the buoy unique ID attached to the FAD (given by the buoy manufacturer), recording in the logbook details of all changes (ICCAT 2016a, Ramos et al., 2017). In addition, two templates are provided for recording activities with FOBs, instead of one, as proposed by Ramos et al. (2017). In this sense the forms included in the Annex 2 and 4 (Rec. 16-01) are not in line with the recommendations made from previous experience and reviews on data collection (ICCAT 2016a, Ramos et al., 2017). ICCAT recommendations also establishes the obligation by CPCs to provide data on FOBs. According to the management recommendations: Rec. 16-01, Rec. 13-01(paragraph 2), ICCAT developed ST08-FadsDep form for data submission to the t-RFMO. Paragraph 23 of Rec 16/01 requested that the CPCs should provide to the t-RFMO (i) the number of deployed FADs with and without beacon, (ii) the average number of active beacons, (iii) the average number of deactivated beacons followed per vessel, (iv) the average number of active lost and (v) the number of FADs deployed by support vessel by month, 1 x 1 square (only specified for some data), FAD and beacon type.

During the 2nd FAD Working Group of ICCAT, the ICCAT Secretariat provided the data received so far from Form ST08 regarding FAD deployments. The Secretariat highlighted that very few CPCs provided data using the recently modified ST08 forms. In addition, several problems with the received submissions were noted. In one case information was provided by 5º x 5º rather than 1º x 1º degree squares, which may be due to a misinterpretation, as the spatial stratification is not specified for all data required (i.e. number of buoys activated and deactivated) (Báez et al., 2017a). This provides an idea of the problems in FAD data submission and underlines the need for standardization and homogenization of the criteria for filling the forms.

In relation to this, Báez et al. (2017a) summarizes the interpretation of EU-Spain with regards to the ICCAT's data reporting requirements for activities on FADs from the Spanish tropical tuna purse seine with the aim to describe the difficulties, posing questions and providing interpretations on the FAD data collection requirements under ST08-Rec 16/01 to allow standardizing the data collection and reporting of FAD information for the fleets that use them.

The main observations and recommendations from Báez et al. (2017a) were:

- Harmonization of the request made in the Recommendation 16-1 under paragraph 23 and the file ST08 FAD Form provided to CPCs to report the data, taking into account the data collection mechanism available.
- Definition of terms and detailed description of each field (i.e. deployed FAD, active beacon, deactivated beacon, lost beacon)
- Harmonization between required information and codes between different Regional fisheries management organizations (t-RFMOs) (e.g. FAD and beacon types)

2.2. IOTC

The Indian Ocean Tuna Commission (IOTC) through IOTC´s Resolution 13/08[9] includes standards for the collection and reporting of data on fishing activities around FOBs, both drifting and anchored, undertaken by purse seine and pole-and-line fisheries. This resolution has been reviewed and updated by 15/08 and, most recently, 17/08. Resolution 17/08 stablish guidelines for FOBs management plans including more strict limitations on the numbers of FOBs, more detailed specifications of data collection from visits to FOBs (Annex I) including date, position, FOB type, identifier and catch and type of visits. In addition, Resolution 15/01 (which superseded Res. 13/03) on the recording of catch and effort data for fishing vessels aims to harmonize data collection and to further monitor FOBs use. It also defines minimum requirements on data collection on FOBs deployments and sets on FOBs (Annex I and II). Although minimum requirements on data collection are provided, none of the resolutions presents specific forms for data collection on FOBs to be used onboard.

Currently, as specified in Resolutions 15/02 and 17/08, and according to the guidelines for the reporting of fishery statistics to the IOTC (Form 3FA, IOTC Secretariat, 2014), CPCs must provide catch-and-effort data in relation to: (i) total number (by type) of FADs deployed by purse seiners and support vessels by month/quarter and fleet, (ii) effort data expressed as the total number of FOB visits per type of FOB, type of visit, 1° grid area and month; and (iii) total catches of target IOTC species and bycatch species taken on FOBs, at the same level of resolution. However, some of the information requested is unclear and the requirements are not harmonized in Resolution 17/08 and Form 3FA (e.g., spatial stratification, or interpretation of the types of visits) (Báez et al., 2017b). The ambiguity in the interpretation of FOB data requirements may result in the development of FAD logbooks not adjusted to the requirements. A clarification of ambiguous details can make possible harmonize data collection.

Báez et al. (2017b) described the difficulties, raised questions and provided interpretations on the FOB collection requirements under Form 3FA to allow standardization among the data submission. Finally, this paper proposes a reorganization of Form 3FA, using CECOFAD conclusions for FOB types and activities.

2.3. IATTC

The Inter-American Tropical Tuna Commission (IATTC) through resolutions C-16-01 (Article 2 and Annex I) and C-17-02 established data collection and reporting requirements for purse seiner vessels operating with FADs on the IATTC Convention area. From 1st of January 2017 the skippers shall collect, and report information contained in the Annex I which referred to activities with FADs, including position, date, hour, FAD identification, FAD design characteristics, type of the activity, the result of the catch when resulting in a set, and buoy

[9] "Procedures on a fish aggregating devices (FADs) management plan, including more detailed specifications of catch reporting from FAD sets, and the development of improved FAD designs to reduce the incidence of entanglement of non-target species". For the purposes of this Resolution, the term "Fish-Aggregating Device" (FAD) means anchored, drifting, floating or submerged objects deployed and/or tracked by vessels, including through the use of radio and/or satellite buoys, for the purpose of aggregating target tuna species for purse-seine fishing operations.

characteristics if any attached to the FAD. To record this information, the working group on FADs designed and proposed a FAD form to be used on board (i.e. IATTC Form: FAD Form 9/2016 which have been recently updated with the FAD Form 9/2018). This new form is composed by two files, one dedicated to record activities on FADs (following the requirements stablished in C-16-01, Annex I) and a second one which should be used as an inventory of active FADs including specifications of the raft and hanging structure. In these IATTC forms, a unique identification is given to FADs, being allowed to use the buoy ID attached or to follow the FAD identification scheme proposed by the IATTC which assigns an independent ID for each FAD. This form structure (activity and inventory in separate forms) and using and independent ID for FADs is not in line with the recommendations made from previous experience and reviews which aim to simplify and adapt to the use on board (ICCAT, 2016c; Ramos et al., 2017).

During 2017, with the establishment of new measures for FADs including limits on the number of active FADs (as refer in the resolution), new reporting requirements were designated (C-17-02). From 1st of January of 2018 CPCs shall report monthly to the Secretariat, with a delay between 60 to 90 days, daily information of all active FADs following the guidelines established by the *Ad Hoc* Permanent Working Group on FADs. In this sense, two files should be reported, which are still under discussion (Lopez et al., 2018), including information about the number of active buoys per vessel and day, and a monthly summary of the activated, deactivated and average number of active FADs followed by vessel and 1º square grid (INF1 and INF2, respectively). The information used to monitor the number of active FADs should be provided by the FAD tracking services directly to the designated verification body of each CPC (and/or to the IATTC staff if so requested by the CPC).

Lopez et al., (2018) recently reviewed the data collection and reporting requirements identifying data gaps regarding FAD logbooks and active FAD information. The IATTC proposed modifications in the CIAT Form 9/2016, which has been conducted in the FAD Form 9/2018, aiming to collect detailed data on FOB (as information about buoys-swapping, re-deployment, including activities with natural objects). However, the form maintains two files (activity and inventory form) and an independent marking scheme for FADs and buoys. To standardize and improve the data collection on FOBs as described in the C-16-01 (Article 2 and Annex 1) and reporting to IATTC, this t-RFMO proposes a web application as data collection tool (Lopez et al., 2018). Finally, aiming to assess the compliance with the C-17-02, the provision of fine scale buoy transmission data from buoy manufactures and VMS data are recommended.

2.4. WCPFC

In the case of the Western and Central Pacific Commission (WCPFC), new FAD/buoy control measures are in force limiting the number of activated instrumented buoys attached to FADs at any given moment to 350 (CMM 2017-01). There are not specified formats for data collection on FOBs for skippers and for data submission to the t-RFMO. The fishing logbook (SPC / FFA Regional Purse-Seine Logsheet) give the possibility to collect some activities with FOBs (i.e. Investigate floating object; Deploy - raft, FAD or payao; Retrieve - raft, FAD or payao) and have the option to characterize the FOB (drifting log, debris or dead animal"; "drifting raft, FAD or payao"; "anchored raft, FAD or payao"; "live whale"; and "live whale shark"). Since 2010, purse seine vessels operating in the Convention Area of this t-RFMO have a 100% observer coverage (as established by CMM2008-01 and following Conservation and Management Measures). The Regional Observer Program includes data collection on FOB activities (WCPFC 2017).

3. Best standards on Data Collection

The lack of unified criteria among t-RFMOs on FOBs data collection, specific guidelines and a standard and easy template for the fleet has resulted in a non-harmonized data collection; which hampers its use for scientific purposes (Ramos et al., 2017). During 2016 and 2017 various works were conducted and presented in t-RFMOs´ working groups to address the problem (Gaertner et al., 2016; Báez et al., 2017a; Báez et al., 2017b; Ramos et al., 2017). Specific details requested by the t-RFMOs are reviewed and discussed, and best standards for data collection are proposed for each requirement.

3.1. Template format:

The forms propose among t-RFMOs (i.e. ICCAT 16/01 – Annex 2 and Annex 3; and IATTC FAD Form 9/2018) are not harmonized and not in line with the recommendations made from previous experience and reviews (ICCAT 2016a, Ramos et al., 2017), which proposed to simplify the marking scheme and structure of the form. When excel files are proposed for data collection, we recommend using a unique form to record all activities on FOB, merging the inventory and activity form as proposed by Ramos et al., 2017; and eliminating the second form or inventory which was previously used in the Spanish FAD Management Plan with limited used and is now proposed by the IATTC (FAD Form 09/2018). This inventory was designed to record the relation and design, or type of the FOBs used. However, it is not a suitable tool to be used on board as it requires a daily update of the list, and hardly provided good quality data (Ramos et al., 2017). Moreover, the information of the dynamics of FOB use can be deduced from the FOB activity form (if information on the structure and material is also given in each record) and information on buoy transmissions if they are made available for scientific purposes to the research institutions or bodies responsible for the verification of compliance with buoy limitations in force. In this situation, the inventory does not provide additional relevant information and, thus, it could be removed to facilitate data collection on board.

On the other hand, in case of purse seiners with Electronic Reporting System (ERS) the FOB logbook and fishing logbook should be linked somehow to minimize the errors due to double recording.

3.2 Data to be recorded:

All interaction with FOBs (FADs or other floating objects) and buoys if present, should be recorded in the FOB logbook while only sets should be recorded on the fishing logbook.

The record of each activity should provide information on buoy attached if present (including the ID of the manufacturer and ownership), specifications on the FOB type and structure allowing the assessment of the entangling and nature of the material, as well as the occurrence and catch of fishing sets, when applicable. Overall, the information provided should also allow the scientists classifying the activities and FOBs in CECOFAD categories (Gaertner et al., 2016).

Some purse-seine vessels work in collaboration with other purse seiners and/or with supply vessels. In these cases, every vessel should register its own activities, even when they are supporting other vessels (e.g., deployment of buoys for another vessel) (Ramos et al., 2017). If vessels working in collaboration are of different flag states, the information on activities should be shared with the corresponding CPC for effort assessment.

Details of each specific information to be collected are included in the tables below. The tables include details of the information required by the t-RFMOs (IATTC, ICCAT, IOTC, and WCPFC) regarding the marking scheme, spatial and seasonal dynamics, FOB type, FOB structure, activity with FOB and buoys, and information on the fishing set/catch. In each case, best standards for data collection and minimum details to be recorded are proposed for a standardize data collection in each case.

3.2.1. Identification

The identification of each activity should be linked with the name of the vessel and IMO number, and starting and end date of the trip. As activities with FOBs could be given between fishing trips (e.g. lost), records between the trips will belong to the next starting trip. Each FOB should be identified by the buoy ID if present. The identification of the buoy in the FOB should be noted (model and identification number) and the ownership of the buoy if known (name of the vessel owing the buoy). The date, time and position of each specific activity (included in the next table) are also crucial for the identification of each record.

General Data	t-RFMOs Data collection Requirements	IATTC	ICCAT	IOTC	WCPFC	Standards for data collection	Minimum Details
Identification	**Vessel**	Required	Not required	Required	-	Required	Name of the vessel fulfilling the form and conducting the activity
	nº of trip/ Identification of the trip	Calendar year of the start of the trip and the consecutive number of the trip for that calendar year in the spaces provided. For example:' 2015-001', denotes the first trip in 2015.	Not required	Not required	-	Required	(*) Start of the trip and its end [= when arriving at port], same as in the logbook
	Register number	Required	Not required	Required	-	Required	IMO number
	Identification (of the locating buoy):	Unique identification number of the locating buoy. If this is a satellite buoy, it must be the unique serial number. If it is another type of locating buoy, use a unique identification code self-provided to the FAD or the locating buoy and that could be used as reference for future encounters.	Required	Required	-	ID Buoy required	Model and identification number
	FAD ID	CPCs shall obtain unique alphanumeric codes from the IATTC staff, or in the alternative, if there is already a unique FAD identifier associated with the FAD (e.g., the manufacturer identification code for the attached buoy), the vessel owner or operator may instead use that identifier as the unique code for each FAD that may be deployed or modified.	FAD Marking and buoy ID or any information allowing to identify the owner. If ID are absent or unreadable, the FAD shall not be deployed	D FAD Marking or beacon ID or any information allowing to identify the owner	-	Not required	Given by the buoy identifier
	Other information not requested				-	Ownership required	Name of the vessel owning the buoy if present

(*) *As indicated for the DEA, the fishing activity is considered to be finished with the arrival at port, the unloading document or the end of the trip (http://www.mapama.gob.es/es/pesca/temas/control-e-inspeccion-pesquera/informacion-sobre-actividad-pesquera/preguntas_diario_electronico_pesca.aspx). For scientific issues, the arrival date should coincide with the unloading date and the date registered in the DEA/ERS.*

3.2.2. Seasonal and Spatial Dynamics

The details on the position, time and date allows exploring the seasonal and spatial dynamics, but also it is indispensable information for the identification of each record.

General Data	t-RFMOs Data collection Requirements	IATTC	ICCAT	IOTC	WCPFC	Standards for data collection	Minimum Details
Seasonal and Spatial dynamics	**Time**	The local time of the event in a 24 hour format (13:00 = 1 pm).	hh:mm.	24-hour format, GMT or local time	-	Required	Time* of the activity in UTC (HHMM) If a loss of the buoy, information of the last transmission should be provided
	Position	Write the geographic location of the event (Latitude and Longitude) in degrees and minutes. Note the corresponding hemisphere (N=North, S=South, E=East, W=West).	N/S/mm/dd or °E/W/mm/dd In case of loss, last registered position	Not specified format	-	Required	Position* of the activity.
	Date	The date of the event in the format DD/MM/YY (day/month/year)	dd/mm/yy	YYYY/MM/DD	-	Required	Date* of the activity.

***** *If a loss of the buoy, information of the last transmission should be provided*

3.2.3. Floating Object (FOB) type

The FOB type should include all types of floating objects and not only FADs. The group recommends recording enough information on the FOB logbook to allow researchers to classify on CECOFAD categories or giving as choice to the fleet the CECOFAD categories (Gaertner et al., 2016):

DFAD: Drifting FAD
AFAD: Anchored FAD
FALOG: Artisanal log resulting from human activity (related to fishing activities)
HALOG: Artificial log resulting from human activity (not related to fishing activities)
ANLOG: Natural log of animal origin
VMLOG: Natural log of plan origin

General Data	t-RFMOs Data collection Requirements	IATTC	ICCAT	IOTC	WCPFC	Standards for data collection	Minimum Details
FOB TYPE	**FAD Type**	1. Natural (log, ropes, pallets/racks, fronds, dead animal); 2. FAD owned by your vessel; 3. FAD owned by another vessel; 4. Anchored object	anchored FAD, drifting natural FAD, drifting artificial FAD: DFAD; AFAD; FALOG; HALOG; ANLOG; VNLOG	drifting natural FAD, drifting artificial FAD),	Not specific fad logbook provided. Given in the fishing logbook drifting log, debris or dead animal"; "drifting raft, FAD or payao"; "anchored raft, FAD or payao"; "live whale"; and "live whale shark".	The information collected should allow to classify in CECOFAD codes	CECOFAD codes could be provided by skippers or could be obtained by posterior analysis of detailed characteristics on FOB

3.2.4. Floating Object (FOB) structure

The information given should allow evaluating the potential of entanglement of the FOB and the nature of the integral material (synthetic or natural and/or biodegradable).

General Data	t-RFMOs Data collection Requirements	IATTC	ICCAT	IOTC	WCPFC	Standards for data collection	Minimum Details
FOB Structure	**FOB Dimension**	Dimensions and material of the floating part (in meters); W –Width -, L –Length–, D –Depth Dimensions of the underwater hanging structure (Not specified format)	Required	Required. Not specified format	-	Dimensions for the floating and hanging structure	Floating structure [aaxbb] (width and length) Hanging structure: depth in m
	Components of the surface structure	Raft: 1. Bamboo Rack; 2. Bamboo in a sausage form; 3. Metallic; 4. PVC or plastic; 5. No raft; 6. Other Wrapping/covering: 1. Entangling net; 2. Non-entangling net; 3. Cloth; 4. Palm fronds; 5. No wrapping; 6. Other Floating devices: 1. Net corks; 2. Plastic buoys; 3. Plastic containers; 4. No floats; 5. Other	Material of the floating part and the entangling or non-entangling feature of the underwater hanging structure	Material of the floating part and of the underwater hanging structure	-	non-entangling character based in ISSF classification scheme and biodegradable character	- Type of material: Natural and biodegradable; or other synthetic materials in the FOB. - Entangling potential of the external mesh size (if present)
	FOB Hanging structure (tail)	Components 1 and 2: 1. Nylon; 2. Palm fronds; 3. Bamboo; 4. No tail; 5. Other Config. (Configuration): 1. Sausage; 2. Ropes; 3. Cloth; 4. Other Mesh size: If the tail is made of net, indicate the mesh size. Otherwise, leave blank.	Material of the underwater hanging structure and the entangling or non-entangling feature of the underwater hanging structure	Material of the floating part and of the underwater hanging structure	-	non-entangling character based in ISSF classification scheme and biodegradable character	-Type of material: Natural and biodegradable or synthetic - Entangling potential of the hanging structure (reference to the mesh size and configuration, i.e. open or coiled)

3.2.5. Type of activity

The group recommends recording enough information on the logbook to allow researchers to classify on CECOFAD categories or giving as choice to the fleet the CECOFAD categories (Gaertner et al., 2016). When any part of the FOB is modified, or the buoy or ownership are changed, the specification prior and after the change should be recorded.

General Data	t-RFMOs Data collection Requirements	IATTC	ICCAT	IOTC	WCPFC	Standards for data collection	Minimum Details
FOB Activity	**Type of the activity on FOB**	Set, deployment, hauling, retrieving, loss, other	Recommends using the terms in CECOFAD: FOB: Encounter, visit, deployment, strengthening, remove FAD, fishing.	deployment, hauling, retrieving, loss	Not specific fad logbook. Given in the fishing logbook as: Set; Searching; Transit; No fishing - Breakdown; No fishing - Bad weather; In port; Net cleaning set; Investigate free school; Investigate floating object; Deploy - raft, FAD or payao; Retrieve - raft, FAD or payao"	CECOFAD activities with FOBs	Recommend using the CECOFAD activities on FOB: Encounter, visit, deployment, strengthening, remove FAD, fishing.
BUOY Activity	**Type of the activity on BUOY**	intervention on electronic equipment,	Buoy: Tagging, remove buoy, loss	intervention on electronic equipment	-	CECOFAD activities with buoys	Recommend using the CECOFAD activities on Buoy: Tagging, remove buoy, loss.

3.2.6. Catch

The FAD logbook should be preferably linked with the fishing logbook when using ERS or dedicated software for standardize data collection and catch obtained from fishing logbook. The destiny of the catch should be included (i.e. retained, discarded or released in case of sensitive species). If the FAD logbook is not linked with the fishing logbook specific fields for the catch should be included in the FAD form

General Data	t-RFMOs Data collection Requirements	IATTC	ICCAT	IOTC	WCPFC	Standards for data collection	Minimum Details
Catch	**Target species**	If the event is a set, the catch in metric tons of each of the tuna species denoted. When the catch includes other tunas (OTH), record the quantities and species under Comments.	If the visit is followed by a set, the results of the set in terms of catch. If the visit is not followed by a set, note the reason (e.g. not enough fish, fish too small, etc.). Estimated catches expressed in metric tons.	If the visit is followed by a set, the results of the set in terms of catch	-	Required. Preferably linked to fishing logbook in ERS and obtained from fishing logbook	Target species (tn). Destiny should be included [retained, discarded]. When the catch includes other tunas (OTH), record the quantities and species as bycatch
	Bycatch	For the groups noted (Sharks – SHRK –, Turtles – TURT –, Billfishes – BILL –, Manta rays – MANT – and Other vertebrates – OTR –), present in the set, indicate either the number of individuals (N) or metric tonnage (t) caught. Use the line below to record the quantity of these, released alive.	If the visit is followed by a set, the results of the set in terms of by-catch whether retained or discarded dead or alive (in case of release expressed as number of specimen.). Estimated catches expressed in weight or in number.	If the visit is followed by a set, the results of the set in terms of bycatch.	-	Required. Preferably linked to fishing logbook in ERS and obtained from fishing logbook	little tuna; other bony fishes; billfishes; sensible species; (n or tones). Destiny should be included [retained, discarded or released in case of sensitive species].

3.2.7. Other Requirements

Some t-RFMOs refer to the specification of the buoy attached to the FOB. This is given by the buoy model and therefore it is not necessary to include another field different from the one provided to the buoy identification.

General Data	t-RFMOs Data collection Requirements	IATTC	ICCAT	IOTC	WCPFC	Standards for data collection	Minimum Details
Others	**Characteristics of any attached buoy or positioning equipment**	1. GPS, SHERPE type; 2. Satellite with eco-sounder; 3. Satellite with no eco-sunder; 4. Other	E.g. GPS, sounder, etc. If no electronic device is associated to the FAD, note this absence of equipment	Serial number required	-	Given by the buoy model	

4. Best Standards on Reporting Requirements

The t-RFMOs aiming to assess the effort on FOBs have strength the data reporting requirements and specific templates has been provided to CPCs for data submission on FOBs. However, some data gaps have been identified for the different RFMOs (Ramos et al., 2017; Báez et al., 2017a; Báez et al., 2017b; Lopez et al., 2018), indicating a generalized problem in data collection and reporting schemes stablished. Some of the potential sources of un-reporting are identified as un-harmonized spatial and temporal stratification of the data required, misinterpretation of the request due to un-specific guidelines, lack of definitions of the terms and variables to be recorded, inadequate templates where information extracted from different sources cannot be integrated in a single template (i.e., information from FOB or FAD logbooks vs. information from buoy transmissions), etc...

In order to provide the t-RFMOs with good quality information on FOBs and facilitate CPCs the collection and submission of data, we reviewed the t-RFMO data reporting requirements and identified best standards.

4.1 Format of the templates:

Regarding to the previous experiences we recommend using two specific templates adjusted to the data collections sources (FOB logbook vs. buoy tracks): one dedicated form to report activities on FOB (based in CECOFAD categories) which are extracted from the FOB or FAD logbooks; and another template dedicated to report information on density of followed and/or owned buoys or FADs, which is extracted from buoys transmission information (examples are included in the Annex 1 and 2, following those proposed by a small working group that met during the ICCAT SCRS 2018 meeting).

4.2 Definition of terms:

The activities with buoys and FOBs, as well as FOB types should be in line with CECOFAD categories.

4.3. Data to be requested:

The information on buoy density should be requested stratified by month and 1ºx1º. This information should be extracted from buoy transmissions provided by buoy manufactures and not from FAD or FOB logbooks. It should be requested by all t-RFMOs.

The data on FOB and buoy activities should be extracted from FOB logbooks. This information should be requested in an independent template. The group aware of the difficulties of logbook analysis and recommends reducing the request to certain activities: deployment, tagging and loss (CECOFAD categories), until the development and implementation of a standardized data collection tool is available and implemented.

4.3.1. Seasonal and Spatial Distribution

The guidelines to CPCs for data reporting in terms of spatial and temporal resolution are not specified for all data required and not harmonized among t-RFMOs, as it refers to 1º or 5º grid square size and to the monthly or quarterly basis. This has resulted in a misinterpretation of the request and inadequate submissions of data (Báez et al., 2017a, 2017b). The group recommends the harmonization to 1º grid square and monthly basis.

General Data	**t-RFMOs Data collection Requirements**	**IATTC**	**ICCAT**	**IOTC**	**Information extracted from FAD Logbook**	**Information extracted from Buoys transmissions**	**Standards for data reporting**
Seasonal and spatial distribution	Grid size	1x1	1x1 (but not specified for all data required)	1x1	X	X	Harmonize grid size:1x1
	Time scale	Monthly	Monthly	Is not harmonized. [Monthly and Quarterly]	X	X	Harmonize time scale to a monthly basis

4.3.2. Floating Object (FOB) Type

The information on FOB types described in each t-RFMO are various, and the group recommend using a single classification based in CECOFAD categories:

DFAD: Drifting FAD
AFAD: Anchored FAD
FALOG: Artisanal log resulting from human activity (related to fishing activities)
HALOG: Artificial log resulting from human activity (not related to fishing activities)
ANLOG: Natural log of animal origin
VMLOG: Natural log of plan origin

The information on FOB type comes from the FAD logbooks and those it should be request in independent template different from the one provided for buoy density (information coming from buoy transmission).

General Data	t-RFMOs Data collection Requirements	IATTC	ICCAT	IOTC	Information extracted from FAD Logbook	Information extracted from Buoys transmissions	Standards for data reporting
FOB TYPE	FAD TYPE	Not required	FAA Anchored FAD FADN Drifting Natural FAD FADA Drifting artificial FAD	IOTC FADs codes: LOG, LGT, NFD, NFT, FAD, FDT, ANF, DFR, DRT	X		CECOFAD categories for information coming from FAD logbooks

4.3.3. Activities with FOBs

The activities should refer to activities described in CECOFAD. The activities are extracted from FOB logbooks and should be requested by t-RFMOs in a separated template, different from the one designated to record information from buoy transmissions.

General Data	t-RFMOs Data collection Requirements	ICCAT	IATTC	IOTC	Information extracted from FAD Logbook	Information extracted from Buoys transmissions	Standards for data reporting
Activities with FOBs	Number of FAD visits per type of FAD	Not required	Not required	Total number of FAD visits (deployment, retrieval/encounter, hauling, revisiting or loss**)** by purse seiners, support vessels	X		Given by CECOFAD activities with FOB
	Number of FADs deployed	The number of FADs deployed on a monthly basis per 1°x1° statistical rectangles, by FAD type (Type: FAA - Anchored FAD; FADN - Drifting Natural FAD; FADA Drifting artifical FAD) indicating the presence or absence of a beacon/buoy or of an echo-sounder associated to the FAD and specifying the number of FADs deployed by associated support vessels, irrespective of their flag;	INF2: No. Deployed belonging to the vessel over the month in 1º degree square	Required (1°x1° statistical and month)	X		Given by CECOFAD activities with FOB
	Numbers of lost FADs	Average numbers of lost FADs with active buoys on a monthly basis	Not required	Required (1°x1° statistical and month)	X		- Given by CECOFAD activities with buoys -The term '*lost*' should refer to the end of the transmission of the buoy, in line with CECOFAD
	Number of sets			Required (1°x1° statistical and month)			Should not be included in FOB related templates as it is provided by other means.

4.3.4. Activities with buoys

The activities should refer to activities described in CECOFAD:

Tagging - Deployment of a buoy on FOB (Deploying a buoy on a FOB includes three aspects : deploying a buoy on a foreign FOB, transferring a buoy (which changes the FOB owner) and changing the buoy on the same FOB (which does not change the FOB owner).
Remove BUOY - Retrieval of the buoy equipping the FOB.
Loss - Loss of the buoy/End of transmission of the buoy.

Specific terms used in t-RFMOs as "activated" or "deactivated" which are poorly defined should be harmonized, by adopting common terms of "deploying" or "Tagging" or "Loss" in CECOFAD. The activities should be extracted from FOB logbooks and should be requested by t-RFMOs in a separated template different from the one designated to record information on buoy density which is derived from buoy transmissions.

General Data	t-RFMOs Data collection Requirements	IATTC	ICCAT	IOTC	Information extracted from FAD Logbook	Information extracted from Buoys trasmisions	Standards for data reporting
Activities with buoys	Number and type of beacons/buoys deployed	Not required	Examples for the type of beacon: e.g. radio, sonar only, sonar with echo-sounder; deployed on a monthly basis per 1°x1° statistical rectangles;	The number of deployments refer to FADs	X		- Given by CECOFAD activities with buoys
	Numbers of beacons/buoys activated and deactivated	No of deactivated belonging to the vessel over the month in 1º degree square	The average numbers of beacons/buoys activated and deactivated on a monthly basis that have been followed by each vessel; the spatial resolution is not specified.	The number of instrumented buoys activated, deactivated on each quarter during 2016 its purse seine vessel under the confidentiality rules set by Resolution 12/02. Required by quarter			- Given by CECOFAD activities with buoys -When referring to the submission of activities with buoys the activated buoy should refer to tagging - The deactivated buoy should reflect the loss

4.3.5. FOB density

The FOB density is estimated by the analysis of daily buoy transmissions which are provided by the buoy manufacturer to the organism responsible of the verification of the compliance with buoy limitation. This information should be provided in a separate template different from the one designated to report data on FOB and buoy activities.

The information provided by the CPCs to t-RFMOs should include at least the average number of buoys owned and followed by vessel in each 1ºx1º square and month

- Year [Year of activity],
- Month [Month of activity],
- CPC
- Number of vessels,
- Latitude [decimal degree],
- Longitude [decimal degree],
- Average number of active FADs or buoys [Average number of active buoys that is transmitting a signal and is drifting in the sea, belonging to the total number of vessels of the CPC over the month]

General Data	t-RFMOs Data collection Requirements	IATTC	ICCAT	IOTC	Information extracted from FAD Logbook	Information extracted from Buoys transmissions	Standards for data reporting
FOB number	Active FADs / buoys	Daily information on all active FADs to the Secretariat, in accordance with guidance developed under Paragraph 12, with reports at monthly intervals submitted with a time delay of at least 60 days, but no longer than 90 days: INF1: Number of active FADs/date INF2: Average number of active FADs belonging to the vessel over the month (by summing up the total number of active beacons recorded per day over the entire month and dividing by the total number of days) in 1 degree square	Average No. Active beacons followed per vessel.	Res 17-08 (9) - the number of instrumented buoys active on each quarter during 2016 its purse seine vessel under the confidentiality rules set by Resolution 12/02		X	Average number of active buoys that is transmitting a signal and is drifting in the sea in 1ºx1º and month Should be reported in a separated form

4.3.6. Catch

The catch data are generally obtained by other sources and in order to avoid data duplication and facilitate the data reporting to CPCs this information shouldn´t be provided in templates designated to report activities on FOBs or data on buoy densities.

General Data	t-RFMOs Data collection Requirements	ICCAT	IATTC	IOTC	Information extracted from FAD Logbook	Information extracted from Buoys transmissions	Standards for data reporting
Catch	Catches and effort	when the activities of purse seine are carried out in association with bait boat, report catches and effort in line Task I and Task II requirements as “purse seine associated to bait boats” (PS+BB).	Not required	Total catches of target IOTC species and bycatch species taken on FOBs, at the same level of resolution (1ºx1º and month) Retained catches: catches for each species retained on board in live weight and/or number. Discard levels: discard levels for each species in live weight or number.			Shouldn´t be required related to information on FOB activities or buoy densities as it is provided in other Tasks

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Annex 1 – FOB logbook

Flag (current) cod.	Month	Lat	Lon	Number of vessels	Vessel Type	FOB type	Buoy Type	No. buoy[10] Deployed	No. FOB[11] Lost

[10] Total number of buoys deployed in the 1-degree square refers only to the first deployment of a FAD with its buoy, the deployment of a buoy on a log [see CECOFAD categories] that was not previously tracked by any vessel, i.e. buoy transfer events are not reported here (i.e. the change of buoy).

[11] FOB that can no longer be tracked by a vessel because the information of the buoy attached is no longer received. It is estimated by summing up the total number of FOB lost per entire month and 1-degree square.

Annex 2 – Buoy transmission Data

Flag (current) cod.	Month	Number of vessels	Lat	Lon	Buoy type	Average No.[12] Of Operational buoy[13]

[12] Average number of operational buoys belonging to the vessels over the month (by summing up the total number of operational buoys recorded per day over the entire month and dividing by the total number of days). It should be provided in 1ºx1º scale

[13] Active buoy that is transmitting a signal and is drifting in the sea